KEEPING THE OPTIONS OPEN

David Ball
Consultant and Technical Advisor to Kidde International
Mathisen Way, Colnbrook, Slough, Berkshire SL3 OHB, UK

INTRODUCTION

In a paper presented at last year's conference 'There will be no "Son of Supergas"' [1], it was suggested that it is by now highly unlikely that true "drop-in" replacements for halons will ever be found. Put simply. this was based on the argument that chemical potency comparable to that of halons can only be achieved (in a gas) with bromine present in the molecule; that this, in isolation, unavoidably brings with it a threat of stratospheric ozone depletion: that. to avoid this threat, it is necessary to introduce into the molecule those species or structures that promote tropospheric breakdown so that the agent, if released, decays before it can reach the stratosphere: that all the strategies so far identified for achieving this involve a significant increasc in molecular weight; and that this. in turn, so reduces volatility that physical behaviour of the candidate new agents is quite different from halons. They are no longer "drop-ins."

The entire fire protection community (including the author) would be delighted if one or more of the several steps of this argument proves invalid. Nor should it lead us to advocate stopping or reducing work on replacements, which even if it produces no "drop-in" may yet identify further useful alternatives for niche or "Critical" applications. However. no counter argument to its logic has yet been put forward, indicating that it would be imprudent to rely on the advent of a "drop-in" or to delay implementing appropriate measures in the hope of the arrival of one.

OUTSTANDING ISSUES

Meanwhile, there continue to be applications where no acceptable alternative has yet been identified. Under the terms of the Montreal Protocol and its Decisions IV/25 and VII/12, a use qualifies as "Critical" only if [2]: (i) it is necessary for the health. safety, or is critical for the functioning of society (encompassing cultural and intellectual aspects): and (ii) there are no available technically and economically feasible alternatives or substitutes that are acceptable from the standpoint of environment and health. Uses meeting these criteria account for only a very small proportion of the applications in which halons were previously to be found, but they include a number of crucial areas such as aircraft passenger compartments. engines. cargo areas (and, for military purposes, dry bays): military crew spaces in vehicles. ships. and critical command centres: control centres that cannot be evacuated, such as in nuclear plants; inerting in some facilities where flammable liquids and gases are handled: and in personal protection for a few specialised police, fire brigade, and military tasks.

Many applications have adopted replacements, hut some of these are, for one reason or other, less than ideal. **All** the currcntly available agents. including halon. have one **or** more undesirable characteristics. Perfluorocarbons have high environmental impact, although they are clean and nontoxic. Hydrofluorocarbons, too, have varying degrees of environmental impact, as, in a different way. do halons themselves and, to a lesser degree, hydrochlorofuorocarhons. Carbon dioxide is toxic in fire-extinguishing concentrations, and, like inert gases, has a high space and weight claim. Water continues to show promise, as it has for a number of years, but generally needs careful application-specific engineering. Foams are excellent in the uses to which they are suited, but these, in general, overlap only slightly with the traditional applications of halons, which they have therefore replaced in only a few areas. Powders, including the recently developed very fine aerosols, are one of the few agents to approach effectiveness comparable with that of halon, but though some are non-toxic, they cannot generally be used where people are present because of inhalation and visibility problems. Cleanup remains an issue.

In these circumstances, it is important for the fire protection community to act to keep open as many choices of approach as possible. Different applications have different needs, which mean that they are more or less tolerant of the different particular shortcomings of different agents. Carbon dioxide, for example, though entirely satisfactory in ground-based facilities where space claim is not a constraint and where evacuation of personnel is possible, is unlikely ever to be very popular in transport uses. Critical Uses, by definition, still have no choice but to continue using halon despite the environmental downsides. Until there is general agreement in any particular application that it has successfully identified a fully acceptable means of providing satisfactory fire safety, it is premature to allow current or potential replacements to be ruled out of consideration.

A distinction will be drawn between technical problems on the one hand and regulatory issues on the other. The former, such as the heavy space and weight claim of inert gases or the residual contamination problems of foams and powders, are the types of issue with which the industry has long been familiar and to which many of the answers are well established. There is widespread agreement on where particular approaches work. When new technical problems arise. it is within the industry's capability and remit to devise technical solutions and to convince users that they are safe and effective. The general unavailability of halon might be considered as such a problem, and one the industry has worked hard to resolve. Its significant success is shown by the long list of new alternatives that have arisen over the last several years as well as a continuing improvement in our understanding of the mechanisms of fire extinguishing, both of which we will hear more of this week.

The fire protection industry is less familiar, less comfortable, and less experienced in regulatory issues, and it is on these that this paper will concentrate, with the aim of showing that they can be addressed with comparable success. Threats of this type are from the Montreal Protocol to halons and hydrochlorofluorocarbons; from the Kyoto Protocol to perfluorocarbons and hydrofluorocarbons; and from groundwater pollution considerations to foams. Technical solutions to the perceived problem are needed as a starting point, but in the case of these regulatory issues, we need also to satisfy other agencies, principally governments and other regulators, of the validity of our standpoint. To see how this might be achieved, we will look at an approach that has achieved at least a measure of success, and then assess how widely it might be used and where else it may be applicable.

KYOTO PROTOCOL AND EMISSION LIMITATION

The inception in 1991 of the series of conferences (HOTWC) of which this is the ninth was in response to the already increasingly severe demands being placed on fire protection by the Montreal Protocol. This was the first International Treaty seeking to protect the global environment. The second is the Kyoto Protocol of 1997[3]. Montreal's objective was protecting the ozone layer; Kyoto's is controlling climate change.

Climate change is **a** postulated mechanism by which man-made gas releases cause significant increase in global mean temperatures through the "Greenhouse Effect." This shifts the global energy balance *as* the accumulating gases transmit short wave incoming solar radiation but block long wave outgoing infrared from the earth's surface. There is strong evidence, despite wide natural variability, that anthropogenic effects ate discernible, but this is not yet completely unequivocal, and scepticism, though dwindling. persists. However, the Kyoto Protocol, like Montreal before it, represents a political decision that the potential consequences are too serious to delay action until the scientific evidence is completely unambiguous.

The Protocol **was** completed on 10 December 1997. Its main provision is that the emissions from industrialised parties of a short list of gases. normalised to their carbon dioxide equivalent, must be reduced by *5.2%* on average by 2008-2012. Promised reductions cover a wide range, dependent on national circumstances. from 8% in Europe (UK 12%, Germany 21%, France 0%), 7% in the **USA,** 6% in Canada and Japan, and so on. "Demonstrable progress" is required by 2005. The gases covered are carbon dioxide, methane, nitrous oxide, sulphur hexafluoride. hydrotluorocarbons, and perfluorocarbons. Assessment is of the overall reduction — there are no requirements for the individual gases. Credit can be claimed for carbon sinks such as changes in land use. The majority of emissions result from natural processes or as side effects of other activities, *so* controls are likely to target emission, not production — an important difference from Montreal.

One effect of the Montreal Protocol was that the fire protection community introduced a number of good practices which dramatically reduced unnecessary emissions from testing. training. venting and other procedures and sources. These practices have generally become standard for new agents as well, and there is strong evidence that the industry can he substantially non-emissive. Generally accepted emission rates such as those used by the UNEP Halon Technical Options Committee are already low at around 4% per year. but indications are that new agents to which a full suite of good practices have been applied from the start (and which are more costly to replenish!). may have rates as low as 1%.

Under the Montreal Protocol. fire protection was *a* small contributor. Under Kyoto, it is tiny. Estimates* suggest that total emissions in carbon dioxide equivalent will be about 16.5GT; of this, tluorocarbons in total might account for 245MT (megatonnes), **less** than 1.5%; and of this in turn, fire protection is unlikely to be responsible for more than 7MT or 3%. This is 0.04% or one two thousand five hundredth (1/2500), of the overall problem.

From the technical viewpoint the fire protection industry has traditionally adopted. the problem might thus seem to have been solved. However. as noted above, in the case of non-emissiveness, we need to satisfy not only ourselves but also others — principally governments (as Parties to the Kyoto Protocol) and perhaps other regulators—of our credentials.

---

* Ward, **B.** H. F., Personal Communication, March 1999.

VOLUNTARY CODES OF PRACTICE

One approach which has had a great deal of success in the UK [4], which is under active consideration by other European countries and has recently generated increasing interest in the USA, is that of the Voluntary Code of Practice (VCOP). Similar approaches have been adopted by a number of other industries [5], and there are published general guidelines for the development of such codes [5]. Essentially, in the case of fire protection, the VCOP is a voluntary reciprocal agreement between government and industry, which recognises that, provided adequate technical procedures are adhered to, fire protection systems are substantially non-emissive (except in the case of fire) and therefore need not be subject to regulatory control.

The industry party to this agreement may consist of an individual company (which was how the process started out in 1994 in the UK) or a number of companies acting together. Better still, an organised grouping such as a trade association may be able to speak for the industry as a whole, or at least a sizeable proportion of it. This, in the form of the Fire Industries Council, is where the responsibility had come to rest in the UK by the time the agreement was concluded in 1996. The government would probably be represented by the Ministry or Department responsible for environment — in the UK, the Department of Environment when negotiations were in progress, now the Department of Environment, Transport, and the Regions.

Such a code might include a number of elements — by way of example, the text of the current UK agreement is included as an appendix to this paper. The Industry might agree to ensure that environmental impact would be one of the issues always taken into account when selecting an agent for a particular installation — alongside the more conventional considerations such as toxicity, weight and space claim, and cost. One approach which might help underpin this is to ensure that the design engineers and installers involved are appropriately trained to agreed standards. There could be an undertaking that only agents which can be recycled will be considered. Quality—of design and installation as well as of hardware, and of detection and control as well as extinguishing equipment — is another area, perhaps in the form of a guarantee that an identified list of appropriate national or international standards will be observed. Already, as implemented in response to Montreal, testing and training discharges have been almost completely eliminated. A minimum level of maintenance after installation might also be guaranteed. Undoubtedly there are other issues that might figure high on the agenda of particular industries or governments, and which could be included as appropriate. In return for compliance with the agreed set of good practices. the industry is recognised by government as substantially non-emissive.

The benefits of adopting an approach of this type include a number which are obvious and others which are less so. An unnecessary proliferation of regulations is avoided. The fire protection industry can maximise the availability of alternatives and options open to it. Policing is largely devolved to the trade association or other industry body party to the agreement. It is left with the industry to use their specialist knowledge to ensure that the best approaches are adopted in each particular case. It helps position the fire protection as environmentally responsible, which is attractive to increasing numbers of users.

Application of this type of approach to other areas would require significant reworking of the details but there seems every prospect that the overall philosophy could be successful. Two areas that might benefit could be foams and Critical Uses. Foam suppliers already choose the least polluting of the effective materials, but perhaps commitments could be made on. for instance. rccyclability, training, and research to minimise or eliminate the remaining chemical components with environmental impact, which together could merit recognition of minimal pollution. Halon is still an option too. and is a second potential beneficiary of VCOP collaboration. As noted, its applications are now restricted to Critical Uses. However, unlike Essential Uses (those. if any. that necessitate new halon production), no mechanism is defined under Montreal for assessment and approval of Critical Uses, which is generally assumed to he left to each national government. A Voluntary Code might provide a mechanism for addressing this issue as well.

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

It is now highly unlikely that a true "drop-in" replacement for halon will be found. Until there is general agreement that fully acceptable means of providing satisfactory fire safety have been successfully identified for all applications, it is in the interests of the fire protection industry to keep as many of its options open as possible. The industry has made enormous progress since the Montreal Protocol came into force in identifying and implementing alternative approaches and overcoming thc technical barriers to their realisation. However, it is also faced with regula-lory hurdles. Somc success has been achieved by the approach of adopting all appropriate measures to minimise emissions and embodying these in a Voluntary Code of Practice agreed with government regulators to underpin the minimally emissive nature of fire protection.

It is demonstrable that the fire protection community can successfully address regulatory as well as technical hurdles by appropriate involvement in the political arena, suitably backed up by practical measures. The approach of reaching an agreement between government and industry in the form of a Voluntary Code of Practice is strongly commended.

It is. incidentally. sobering to wonder what (if any) effect the early adoption of an approach of this type would have had on the impact of the Montreal Protocol on fire protection.

REFERENCES

1. Ball, David, Chattaway, Adam, and Spring, David J., "There Will Be No "Son of Supergas," *Proceedings*, Halon Options Technical Working Conference, Albuquerque, NM, pp. 45-56, 1998.
2. *Handbook for the International Treaties for the Protection of the Ozone Layer*, 4th Edition, UNEP, 1996
3. *Kyoto Protocol to the United Nations Framework Convention on Climate Change*, 1997
4. *Voluntary Agreement Between UK Government and the Fire Industry Concerning the Use of HFC and PFC Fire Fighting Agents*, Department of the Environment, Trade and the Regions and the Fire Industries Council, 1997
5. *Voluntary Industry Codes of Conduct for the Environment*, Technical Report No 40, UNEP IE, 1998

APPENDIX

VOLUNTARY AGREEMENT BETWEEN UK GOVERNMENT AND THE FIRE INDUSTRY CONCERNING THE USE OF HFC AND PFC FIRE FIGHTING AGENTS

"Climate Change - The UK Programme," published by the Government in January 1994, sets out to fulfil the commitments contained in the UN Framework Convention on Climate Change (FCCC). It outlines measures aimed at returning emissions of greenhouse gases to 1990 levels by the year 2000. The most notable of these are CO_2, (except where used for fire protection), methane and N_2O, but reference is also made to other gases including hydrofluorocarbons (HFC) and perfluorocarbons (PFC) because of their high global warming potentials. HFCs and PFCs are being commercialised as replacements for ozone-depleting substances such as Chlorofluorocarbons (CFC) and halons.

A stated aim of the Programme is to avoid damaging current efforts to phase out ozone depleting substances and the Government recognises that the accelerated and successful halon production phase out is due in part to the commercialisation of replacement systems using HFCs and the potential availability of systems using PFCs.

The Government confirms that there is no plan to ban the production or import of HFCs and PFCs for fire fighting applications which are considered as non-emissive uses, except for their very rare use in the actual suppression of fires when the control strategies set out below are applied. The Government further accepts that the use of HFCs or PFCs is appropriate in fire fighting applications where careful evaluation shows them to be the best choice when other practical considerations of personnel safety, cleanliness, speed of suppression, space, weight and cost are taken into account.

The UK fire industry fully supports the Government's objective of progressive reduction in emissions of potentially global warming gases. and when evaluating alternative fire suppression agents, minimising global worming will be one of the issues considered. However, the fire industry's overriding concern remains that there should be no resultant threat to people and property whose safety is protected by their products. With the aim of ensuring that both these ends are achieved, the fire industry, therefore, voluntarily agrees that the strategies sent out below will be applied.

Emission Control Strategies:

- Use leak-free storage equipment to BS 5306, **BS** EN3: 1996, BS 7867: 1997, and BS 7863: 1996 or equivalents.
- Use approved, high quality detection systems to **BS** 5839 and BS EN54 or equivalent.
- Use approved control equipment to BS 7273 or equivalent.
- Ensure that installations are inspected regularly in accordance with the relevant BS.
- Eliminate the discharge of agent in system testing unless required by regulation.
- Support the Government in pressing for the revision of such regulations.
- Eliminate discharge of agent in training.
- Reclaim agent for re-use.
- Recycle using facilities registered with HUNC and listed to FIC Code of Practice.

The Fire Protection Industry undertakes to report annually to the Department of the Environment, Transport and the Regions in the first half of the following year on the mass of greenhouse gases and its global warming CO_2 equivalent emitted from fire protection systems in the United Kingdom, commencing January 1997. The Government and the fire protection industry undertake to meet at least annually to review this voluntary agreement and any actions resulting from it.